norm by which the aggregate is defined. Or again, page 239, " . . . an aggregate has a cardinal number only when it is one of a plurality of equivalent aggregates, distinct from one another." Again, what success can be expected from an attempt to clarify the notion of aggregate by the introduction of a new word, "norm," itself of debatable meaning? Professor Hobson intimates that something must be "universally accepted" to be admitted as mathematical knowledge; but he does not mention the attack made by Brouwer and Weyl upon some of the fundamental theorems in Analysis. Still again, it may be asked, if (page 6) "the justification [for a certain assumption] is to be found in the fact that no contradiction arises in the theory based on it," why is not the multiplicative axiom justified? Zermelo's *Grundlagen* have led to no contradiction.

The present edition is "revised throughout"; "the parts of the subject dealt with in the first five chapters of the first edition have been expanded into the eight chapters of the present volume." This expansion is due chiefly to the recent developments in the Theory of Integration. The theories of Hellinger, Young and Denjoy are also included. The mathematical world owes a debt of gratitude to Professor Hobson for presenting in a smooth, connected exposition a huge mass of research, a considerable part of which is of recent origin.

The style is, on the whole, very lucid, great pains being taken to prepare the reader's mind for the reception of new ideas. However, here and there we find a lack of compactness—witness the proofs that cover pages 97 and 98, and which may be compressed into one tenth of the space by the use of points with rational coordinates. The treatment retains, in part, something of the freshness of a memoir and will thus prove more stimulating, in one way, than treatises written with a constraining finish.

At this late date, strange to say, the definition of cardinal number as given by Professor Hobson is not without an objectionable feature. Russel is right. Professor Hobson's reference to the "degree of plurality" is like saying, "You know what I mean"; it does not make his definition mathematically acceptable.

On page 259 occurs the following statement: "No elaborate theory is required for functions which retain their complete generality, . . . since few deductions of importance can be made from that definition which will be valid for all functions." It may be of interest to remark that this view is rendered untenable in the light of the results to be announced soon in the *Proceedings of the National Academy of Sciences* in a paper by the reviewer, entitled "New Properties of All Real Functions."

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Analysis Situs. The Cambridge Colloquium Lectures, Part II, Vol. V. By OSWALD VEBLEN. Published by the American Mathematical Society, 501 West 116th Street, New York. 150 pp., octavo. 1922.

The Cambridge Colloquium lectures on Analysis Situs were delivered in 1916, but the publication having been postponed because of the war, the lectures were completely rewritten before publication, and the resulting book is a treatise on the elements of Analysis Situs. It is furthermore the only modern book on the subject. By a study of this book it is possible to acquire a knowledge of Analysis Situs without going through the many widely scattered memoirs as was formerly the case. Every one interested in Analysis Situs will welcome Professor Veblen's book as an important and useful contribution to the subject. Part I by G. C. Evans on Functionals and their Applications was published in 1918.

H. L. RIETZ

SPECIAL ARTICLES

ZOSTERA MARINA IN ITS RELATION TO TEMPERATURE[1]

IN connection with some work on the temperature control of the geographical distribution of the marine algæ, it seems to be demonstrated that the terms eurythermal and stenothermal apply only to the power of endurance of a wider or narrower range of temperature

[1] Preliminary communication.

without indicating definitely, as least in the case of the eurythermal species, just what temperature limits are vitally concerned with the persistence of the species. An attempt has been made to establish definite temperature zones, to each of which certain species are normal, and to explain the presence of any species, normal to one zone, in a zone of different temperature, by the fact that the invaded zone, as it was designated, has its temperature raised or lowered to that of the normal zone of the species by some agency or condition, local or general, and for a sufficient length of time to allow of the reproductive processes of the invading species to be effectively carried on. This idea has been set forth in an article entitled "Stenothermy and Zone Invasion." (*Amer. Nat.,* Vol. 54, pp. 385-397, 1920.)

In connection with this investigation, it seemed very desirable to attempt to determine the behavior of a group of aquatic plants other than the Algæ and I turned my attention to the marine spermatophytes, popularly known as sea grasses, eel grasses, or grass wrack. The inquiry, at first, was purely statistical, merely assembling what was known of these plants as to their distribution, their times of flowering, and the relation of their distribution and flowering to isothermal lines of temperature, especially to those of the maxima. The results of this inquiry are set forth in a paper entitled "Geographical Distribution of the Marine Spermatophytes" (*Bull. Torrey Bot. Club,* Vol. 47, pp. 563-579, 1920). It seems, from the data available, that out of 34 known species, 26 are stenothermal, *i. e.,* confined to a single zone of temperature of 5° C. amplitude of the maxima; 6 are somewhat eurythermal, occurring in two such zones; and 2 are broadly eurythermal, occupying 3 or more of such zones. Of the last category, *Zostera marina* L., the common eel-grass of the north Atlantic coasts, is the most pronounced and the most puzzling. After assembling such data as were readily available as to season of reproduction in different portions of its range, I ventured to suggest that the normal zone of *Zostera marina* L. must be the North Temperate, whose waters possess a summer temperature of 15° to 20° C., and that the

extension of the distribution of this species as far north as the Upper Boreal is due to the effect of insolation upon the shallow, enclosed waters of its habitat in the invaded zones, and, on the other hand, that the invasion southward into the northern portion of the Tropical Zone is possible on account of the seasonal lowering of the temperature of the waters during the winter and spring.

Since I am able to visit the Atlantic Coast only at very infrequent intervals, I appealed to correspondents and to the U. S. Commissioner of Fisheries to assist in determining the exact status of the temperature conditions of the life-history of *Zostera marina* L. The Commissioner promptly and favorably responded and issued instructions to make the collections desired at the stations at Key West, Florida, Beaufort, N. C., and Woods Hole, Mass. At the Key West station, Ezra Stiles, Jr., early demonstrated that *Zostera marina* L. is absent but that the Turtle Grass, *Thalassia testudinum,* is abundant and presents certain problems. With the transfer of Mr. Stiles to an inland station these observations came to an end. At the Beaufort station, Charles Hatsel, and at two very different localities at Woods Hole, R. A. Goffin have made collections monthly or bi-monthly for some seventeen or eighteen months, together with the proper temperature data. I am deeply indebted to these members of the staff of the Bureau of Fisheries for their most valuable and painstaking cooperation.

I, myself, was able to supplement the observations at the stations of the Bureau of Fisheries by collections made at various stations about Narragansett Bay, R. I., in May, June and July of 1921, and Professor Thurlow C. Nelson of the New Jersey Agricultural Experiment Station kindly made collections throughout the year at stations of the Oyster Commission on the coast of New Jersey.

Since *Zostera marina* L. grows in extensive patches, whose individual plants are fairly uniform in behavior, all that is necessary is to gather a fair sized bunch of plants, dry and forward with the proper data. The extensive mass of material accumulated has not been critically gone over as yet, but sufficient exam-

ination has been made to show that it will assist greatly in unraveling the intricacies of the life history of this species from the point of view of morphological changes and their relation to temperature variation. One fact, indeed, is clearly apparent and that is this: the reproductive season begins at 15° C. or very close to it and extends only to 20° C. or closely in its neighborhood. The vegetative processes preceding anthesis and maturing of seed have also fairly narrow, but different, temperature relations, as do also those succeeding the maturing of seed. The active period of growth and reproduction seems to be normally included within an interval of 10° C., *i. e.*, from 10° C. to 20°. During the colder as well as during the warmer periods of the year, according to the particular zone, normal or invaded, *Zostera marina* L. enters into a state of quiescence, total or nearly so, but revives when the proper temperature for vegetative activity of one sort or the other comes again. The material now in my hands as the result of this cooperation seems ample for clearing up these points, and a more detailed report is in preparation.

There seems to be no dependence on a particular period of illumination in the case of the various stages of growth and reproduction —in other words, no photo-periodism in the sense of Garner and Allard. This negation stands out very clearly.

WILLIAM ALBERT SETCHELL
UNIVERSITY OF CALIFORNIA,
     AUGUST 23, 1922

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY
S. E. Sheppard, *chairman*
Robert E. Wilson, *secretary*

Experimental studies of the radiation hypothesis: FARRINGTON DANIELS. The decomposition of nitrogen pentoxide is a favorable reaction for testing deductions from the radiation hypothesis, since it is a unimolecular, gas phase reaction which takes place at room temperature. The influence of the temperature of the walls of the containing vessel and their optical nature have been investigated. Nitrogen dioxide is an important factor in determining its velocity. The influence of various solvents has been studied. The effect of visible and infra red light has been investigated. Experiments have been carried out to determine whether the vessel walls can supply sufficient energy to cause the reaction. A search has been made for the emission of light predicted on the basis of the radiation hypothesis.

Some deductions from statistical mechanics: W. H. RODEBUSH. Marcelin derived an equation for the temperature coefficient of the rate of a chemical reaction which agreed with the empirical Arrhenius equation. Tolman has shown that this derivation was incorrect. A rigorous derivation of a similar equation is given. By combining this equation with the assumptions of the quantum theory a physical basis is obtained for the empirical equation of Dushman, which has been shown to have considerable validity. The equation contains a constant which is characteristic for the molecule involved so that complete validity of the Dushman equation for all different kinds of molecules could not be expected.

The "creepage" corona, a new type of silent discharge: F. O. ANDEREGG and H. E. BOWERS. The effect of a dielectric material in an electric field has been studied by C. W. Rice *(Proc. Am. Inst. Elec. Eng.,* 1917). K. B. McEachron has found that glass rods may increase the yield of ozone *(Purdue Univ. Eng. Expt. Sta. Bull. 7).* A study of their results shows that the action of the dielectric material in the "creepage" discharge is probably partly catalytic. Experiments have been made with a variety of dielectric materials including fragments of ordinary glass, quartz glass and of earthenware, with and without beeswax impregnation; also blue and white flint and of hematite. The effect of these materials upon air and upon carbon monoxide subjected to a silent discharge has been studied under a variety of conditions. Preliminary results are given, strongly supporting the contention that catalytic action and ionic activation are superimposed in this type of discharge.

The effect of container walls on chemical reactions in the corona: F. O. ANDEREGG and K. B. McEACHRON. In the effort to trace out the causes which contribute to the common lack of reproducibility in results, in the study of chemical reactions in the corona discharge, experiments have been extended over a considerable period of time. The surface of metallic electrodes is disintegrated so that "polarization" and variation in chemical action may result. If a dielectric mate-